CHAPTER 1: INTRODUCTION

Bridge bents are often supported by shallow foundations, piles, drilled shafts, or a combination of these types of foundation. For example, the foundation for the New Bern Bridge consisted of more than 1000 piles and more than 800 drilled shafts. In general, and as described by NCDOT engineers, the design process for drilled shaft bents proceeds by conducting analysis using a computer program to estimate the load combinations on the bent under various AASHTO loading conditions. Geotechnical analyses of the laterally loaded single shaft are also conducted to estimate the shaft length and designate a corresponding point of fixity. The bent is then modeled using frame analyses to estimate bending moment and shear forces for structural design. For buckling analysis, an equivalent length K-factor of 1.9 to 2.1 is assumed in the longitudinal direction (assuming nearly free head conditions) while a K-factor of 1.2 is used in the transverse direction (assuming translation with no rotation).

Robinson et al (2006) proposed an approach for estimating the point of fixity based on matching the moment and pile top deflection from the geotechnical analysis with a statically equivalent system. Such an approach indirectly accounts for the presence of the soil around the pile, or shaft, from the point of fixity to the ground surface. Robinson et al (2006) also indicated the need for an accurate estimation of the rotational stiffness of typical NCDOT superstructure to substructure connections, as such stiffness affects the assumption of the boundary conditions at the pile, or shaft, top as well as the assumed value of the K-factor. The depth to fixity and effective length factors, as currently evaluated, may not be suitable for all conditions especially when the top boundary condition can be characterized as partially fixed. This can be the case if the bearing pads are capable of transferring moment between the superstructure and the cap beam. Estimation of the rotational stiffness is particularly important in the longitudinal direction for bridges with elastomeric bearings and diaphragms over the cap-beam connecting adjacent girders. In this case, NCDOT currently assumes that the K-factor for effective length is 2.1 (free head).